

- Q1.** If $y = (x + \sqrt{x^2 - 1})^2$, then show that $(x^2 - 1)\left(\frac{dy}{dx}\right)^2 = 4y^2$. **2 Marks**
- Q2.** If $y = (x)^{\cos x} + (\cos x)^{\sin x}$, find $\frac{dy}{dx}$. **4 Marks**
- Q3.** if $y = \sqrt{\frac{(x-3)(x^2+4)}{3x^2+4x+5}}$, find $\frac{dy}{dx}$ **4 Marks**
- Q4.** A ladder 5 m long is leaning against a wall. The bottom of the ladder is pulled along the ground, away from the wall, at the rate of 2 cm/s. How fast is its height on the wall decreasing when the foot of the ladder is 4 m away from the wall? **4 Marks**
- Q5.** If $y = x^3(\cos x)^x + \sin^{-1} \sqrt{x}$, Find $\frac{dy}{dx}$. **4 Marks**
- Q6.** If $x^y + y^x = a^b$, then find $\frac{dy}{dx}$. **4 Marks**
- Q7.** Sand is pouring from a pipe at the rate of $12\text{cm}^3/\text{s}$. The falling sand forms a cone on the ground in such a way that the height of the cone is always one-sixth of the radius of the base. How fast is the height of the sand cone increasing when the height is 4cm? **4 Marks**
- Q8.** Find the absolute maximum and minimum values of a function f given by $f(x) = 2x^3 - 15x^2 + 36x + 1$ on the interval $[1,5]$ **4 Marks**
- Q9.** Find $\frac{dy}{dx}$ in the following cases:
 $y^3 - 3xy^2 = x^3 + 3x^2y$ **4 Marks**
- Q10.** If x and y are connected parametrically by the equations given in Exercise without eliminating the parameter, Find $\frac{dy}{dx}$.
If $x = \sqrt{a^{\sin^{-1} t}}$, $y = \sqrt{a^{\cos^{-1} t}}$, Show that $\frac{dy}{dx} = -\frac{y}{x}$ **4 Marks**
- Q11.** If $y = (\cot^{-1} x)^2$ prove that $y^2(x^2 + 1)^2 + 2x(x^2 + 1)y_1 = 2$. **4 Marks**
- Q12.** If x and y are connected parametrically by the equations given in Exercise without eliminating the parameter, Find $\frac{dy}{dx}$.
 $x = a\left(\cos t + \log \tan \frac{t}{2}\right)$, $y = a \sin t$ **4 Marks**
- Q13.** Find the absolute maximum and minimum values of a function f given by $f(x) = 12x^{\frac{4}{3}} - 6x^{\frac{1}{3}}$, $x \in [-1, 1]$ **4 Marks**
- Q14.** Differentiate w.r.t. x the function in Exercise:
 $x^x + x^a + a^x + a^a$, for some fixed $a > 0$ and $x > 0$ **4 Marks**
- Q15.** If $y = x \sin^{-1} x + \sqrt{1 - x^2}$, prove that $\frac{dy}{dx} = \sin^{-1} x$ **4 Marks**
- Q16.** Determine the intervals in which the function $f(x) = x^4 - 8x^3 + 22x^2 - 24x + 21$ is strictly increasing or strictly decreasing. **5 Marks**

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- Q17.** Show that the height of the cylinder of maximum volume that can be inscribed in a cone of height h is $\frac{1}{3}h$. **5 Marks**
- Q18.** If $x\sqrt{1+y} + y\sqrt{1+x} = 0$, prove that $(1+x)^2 \frac{dx}{dy} + 1 = 0$ **5 Marks**
- Q19.** If $(\sin x)^y = (\cos y)^x$, Prove that $\frac{dy}{dx} = \frac{\log \cos y - y \cot x}{\log \sin x + x \tan y}$ **5 Marks**
- Q20.** If $e^y = y^x$, prove that $\frac{dy}{dx} = \frac{(\log y)^2}{\log y - 1}$ **5 Marks**

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